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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : A61M 5/168 — A1

(11) International Publication Number: WO 99/42151

(43) International Publication Date: 26 August 1999 (26.08.99)

(21) International Application Number: PCT/GB99/00508

(22) International Filing Date: 18 February 1999 (18.02.99)

(30) Priority Data:
9803299.8 18 February 1998 (18.02.98) GB

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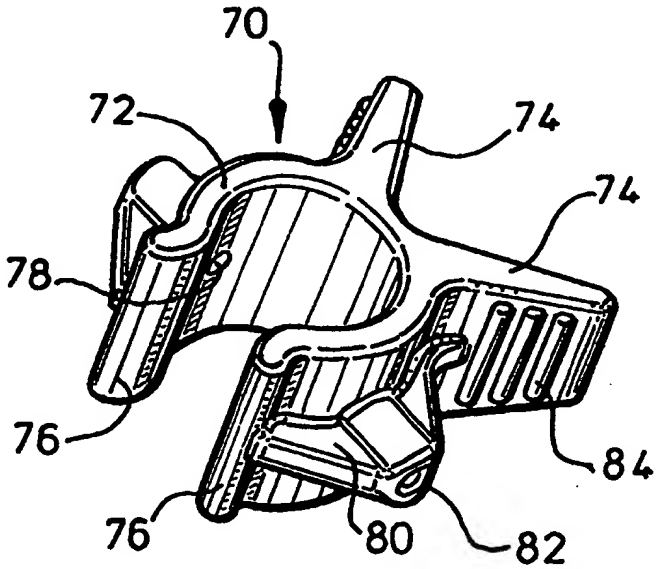
(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: A METHOD AND APPARATUS FOR MONITORING INTRAVENOUS DRIPS



(57) Abstract

A method and apparatus for monitoring intravenous drips by the transmission and detection of a signal, for example red light, through a fluid flow passage whereby detection of a signal of a given intensity activates an audible or visual indicator. A bracket (10) is attached around a fluid flow passage (20) of the intravenous drip and a signal is transmitted across the passage via optical fibres (8a, 8b). The intensity of the signal is detected by a sensor contained within a remote housing (6).

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Title: A method and apparatus for monitoring intravenous drips

DESCRIPTION

The present invention relates to an improved method and apparatus for monitoring intravenous drips.

Intravenous drips are frequently used to administer a continuous flow of fluid to a patient over a given period of time. The drip may administer saline solution to the patient to prevent dehydration and increase blood volume or other fluids, such as insulin, blood or gelofusin. The intravenous drip has a bag containing the fluid which is attached to a filter chamber. This leads to a reservoir which has a piece of tubing extending therefrom which feeds fluid through a needle into the vein of a patient.

The drips are checked at regular intervals by nursing staff to ensure that the fluid is still flowing through the apparatus into the patient. This is time consuming for the nursing staff and additionally, results in the patient being disturbed during the night when the nurse has to check that the drip is still working correctly. Some essential fluids are pumped into the patient via the intravenous drip to ensure that the correct amount of fluid is being administered but the majority of fluids enter by means of gravity, with the bag of fluid being positioned above the height of the patient such that the fluid drips down the tubing and is delivered into the vein of

the patient. This necessitates careful monitoring of the drip by nursing staff to ensure that sufficient fluid is being administered to the patient.

One direct injection pump is that marketed under the name I-VAC™ which uses a pericycle pump to administer a measured amount of fluid to the patient. This type of pump ensures that the fluid is delivered in the correct dosage to the patient but is only used in life threatening situations for the delivery of essential fluids. This type of pump is expensive and therefore not readily available for use with all patients and furthermore, is very heavy. This is obviously undesirable because the apparatus must be taken with the patient when leaving his hospital bed. The pump is also unsuitable for use in certain departments of the hospital, such as the radiography department.

It is an aim of the present invention to provide a method and apparatus for monitoring the flow of fluid through an intravenous drip which is lightweight and relatively cheap to manufacture.

It is a further aim of the present invention to provide a method and apparatus for monitoring the flow of fluid through an intravenous drip thereby removing the need for a nurse to frequently check the drip to ensure that the fluid is being administered to the patient.

Yet a further aim of the present invention is to provide a method and apparatus for monitoring the flow of fluid through an intravenous drip which has no detrimental effect on the fluid administered and does not interfere with other equipment which may be operating in the

vicinity of the apparatus.

Accordingly, a first aspect of the present invention provides a method for monitoring the flow of fluid through an intravenous drip comprising the steps of transmitting a signal through a fluid flow passage and detecting the signal transmitted through the passage whereby detection of a signal of a given intensity activates an audible or visible indicator.

According to a second aspect of the present invention there is provided an apparatus for monitoring the flow of fluid through an intravenous drip comprising a signal transmitter for transmitting a signal through a fluid flow passage, a sensor for detecting the signal transmitted through said passage and at least one visible or audible indicator for indicating the presence or absence of a flow of fluid through the drip.

The signal used in the method and apparatus of the present invention may be infra-red light produced from an infra-red emitter. Alternatively, a red or other light source may be used. Preferably, this signal is transmitted to the intravenous drip by means of an optical fibre. A through-scan, in the form of a bracket, is preferably provided for placement around a region of the intravenous drip for allowing transmission of the beam across the passageway of the flow of fluid. A further optical fibre is preferably attached to the opposite side of the through-scan to receive the signal transmitted through the passage and deliver the signal to the sensor.

The through-scan in the form of a bracket is preferably hinged to allow easy placement around a region of the intravenous drip, such as the chamber or drip pod. Adjustable

fastenings may be provided to fasten the bracket around the intravenous drip. The bracket may be made of any suitable material but preferably is made of a lightweight plastics material. More preferably, the through-scan is in the form of a C–shaped bracket which is provided with a living hinge to allow the opening in the bracket to be expanded to fit around a region of the intravenous drip and then relaxed such that the bracket grips the drip. Preferably, the C–shaped bracket is provided with two arms extending from the rear thereof, opposite the opening, which may be pressed together to cause divergence of the free ends of the C-shaped bracket. The arms are preferably provided with gripping means on their outer surface. The bracket and arms may be produced as a single moulded plastics unit.

Preferably, a housing, for example in the form of a pocket-sized box is provided for the electronic circuitry, sensor and infrared emitter. The housing is preferably made of a lightweight plastics material. Preferably, the sensor is linked to an indicator in the form of a light emitting diode which becomes illuminated when the flow of fluid stops. It is preferable that the light emitting diode is visible through the box. Alternatively or additionally, the sensor may be linked to an audible alarm.

In a preferred embodiment of the present invention, the sensor is linked to a bicolour LED which emits a green light when fluid is flowing through the apparatus and changes to a red light when the flow of fluid stops for a predetermined period of time. This change may be achieved when the sensor receives a predetermined amount of energy within a given period of

time indicating that the infra red signal has not been broken by fluid flow. Preferably, the timing is adjustable. The green light may flash with each drip of fluid that passes through the intravenous drip to confirm that the apparatus is working correctly.

Alternatively or additionally, the sensor may be linked to suitable electronic circuitry to allow the number of drops of fluid which are fed from the intravenous drip within a set period of time to be determined, for example drops per minute. Preferably, the number of drops which pass through the apparatus within the set period of time is visible on a display unit, such as a LCD or LED unit provided on the housing or elsewhere.

More preferably still, the housing is provided with a indicator to demonstrate that fluid is flowing through the drip and a separate display unit, such as an LCD which illustrates the rate of flow of fluid passing through the apparatus. Preferably, the apparatus may be preset at a particular rate whereby the indicator emits a specified colour or other sign when the apparatus is detecting a rate within a specified range of the preset value. Preferably, the indicator will change to another colour or different sign if the number of drops detected falls below or rises above a predetermined tolerance level, such as ± 50% of the preset value. The indicator may also undergo a corresponding change if no drops are detected within a given period of time.

The apparatus may be powered by means of a battery or mains supply. Preferably, a battery is provided in the housing together with a battery recharger which may be linked to the mains supply. A tricolour LED may be included in the apparatus in place of a bicolour LED,

with the third colour of light indicating when the battery is low. Alternatively, a separate indicator may be provided, for example, on the housing, to indicate when the battery is low. The housing is preferably provided with a clip or hook for attachment to the patient, drip stand or elsewhere.

The indicator may also comprise a beacon positioned by the patient or at a nursing station which lights up when the flow of fluid has stopped for a given period of time. Preferably, the beacon is provided on the top of a tall stand. Alternatively, or additionally, a wire may extend from the optical fibre to a glass bulb or light emitting diode which may be placed for example at the top of the drip or drip stand to provide increased visibility of the indicator. The sensor may also be linked to a computer monitor at a nursing station.

The housing may be linkable to an extension lead which may be attached to the optical fibre lead, for example by means of a screw mechanism, to allow an intravenous drip having the through-scan attached thereto to be remote from the housing. This is particularly desirable for when a patient is entering a high risk area, such as a scanning area, whereby the housing may be left outside the area. A receiver, preferably wall mounted, may be provided outside the area for storage of the housing and to allow the drip to be monitored whilst the patient is in the high risk area.

The method and apparatus of the present invention may further provide means for monitoring the amount of fluid which has been administered to a patient. The amount of light

which passes through a drop of fluid and the number of drops counted by the sensor within a given period of time may be used to establish the volume of fluid administered, using appropriate calibrations for particular fluids, for example, the number of ml administrated per hour. The volume per hour may be displayed on a display unit, such as an LCD unit provided on the housing or elsewhere. A computer may collect data for a large number of intravenous drips which may be displayed on a computer screen.

For a better understanding of the present invention and to show more clearly how it may be carried into effect, reference will now be made by way of example only, to the accompanying drawings in which:-

Figure 1 is a schematic diagram of a conventional intravenous drip;

Figure 2 is a schematic diagram of an apparatus according to one embodiment of the present invention;

Figure 3 is a schematic diagram of the apparatus shown in Figure 2 attached to the intravenous drip shown in Figure 1;

Figure 4 is a block diagram of the basic sequence of steps for emitting a green light using the apparatus of the present invention;

Figure 5 is a block diagram of the basic sequence of steps for emitting a red light using the apparatus of the present invention;

Figure 6 is a diagram of the circuitry that may be contained in the box of the apparatus

shown in Figures 1 and 2;

Figure 7 is a flow diagram of the sequence of steps in a further embodiment of the method of the present invention;

Figure 8 is a schematic diagram of a housing of the apparatus according to another embodiment of the present invention;

Figure 9 is a schematic diagram of a housing of the apparatus according to yet a further embodiment of the present invention; and

Figures 10a to 10c illustrate a preferred embodiment of a through-scan for the apparatus of the present invention.

Referring to Figure 1 of the accompanying drawings, a standard intravenous drip for administering fluid to a patient is illustrated. The fluid F, such as saline solution, is stored in a bag 18 which is attached to a chamber 20 containing a filter 21. This is linked to a reservoir 22 having a length of tubing 24 extending therefrom which delivers fluid to a needle (not shown) which is inserted into a vein of a patient. The rate of flow of the fluid through the tubing may be altered by adjusting the ball valve 26. Generally, the bag 18 is hung from a drip stand 28 by the patient's bed and a nurse checks the drip at regular intervals to ensure that the required fluid is being delivered to the patient. If the patient moves away from the bed, the drip must remain attached to the patient and hence, the drip is transported with the patient by the provision of wheels on the base of the stand.

Figures 2 and 3 of the accompanying drawings show one embodiment of an apparatus according to the present invention for monitoring the flow of fluid through an intravenous drip. The apparatus uses a beam of infra red light to detect a drip of fluid passing through the chamber 20 of the intravenous drip. The apparatus comprises a portable housing, in the form of a box 6, which contains an infra red emitter and various electronic circuitry, such as a sensor, ganged relay and timer.

The infra red emitter transmits a beam of infra red light along an optical fibre 8a to a through-scan 10 in the form of a bracket. The bracket illustrated is dimensioned to fit around the chamber 20 of the intravenous drip but may be constructed to fit around another region of the drip, if desired. The bracket is provided with a hinge 16 and adjustable fastenings 14 to allow the through-scan to be attached to chambers of various sizes. The box and bracket may be made of any suitable material but preferably are made of a lightweight plastics material by conventional moulding techniques.

A second optical fibre 8b extends from the opposite side of the bracket 10 such that a path of light may travel from fibre 8a, through the chamber to fibre 8b for delivery back to the box 6 and detection by the sensor contained within the box. It is to be appreciated that the entry into and exit from the through-scan must be perfectly aligned to allow accurate transmission of the signal to provide a viable reading. The circuit is unbroken when no fluid passes through the chamber but is broken as soon as a drop of fluid passes from the bag 18 into

the chamber 20 and to the reservoir 22. In this manner, the continual transmission of a beam of high light intensity to the sensor may be used to detect that the flow of liquid through the drip has stopped and hence, that the fluid is no longer being delivered to the patient.

The sensor is preferably linked to a circuit which has a light emitting diode (LED) which becomes illuminated when the flow of fluid stops. Preferably, a bicolour LED is provided which emits a green light when fluid is flowing through the apparatus and a reduced amount of infra red light is being received by the sensor (see Figure 4 of the accompanying drawings) which changes to red when the flow of fluid stops. This change is brought about when a predetermined amount has energy has built up over a given period of time, for example 10 seconds, indicating that the infra red signal has not been broken by a drip of fluid, as shown in Figure 5. Circuitry may be installed such that the green light flashes with each drip of fluid that passes through the chamber to confirm that the apparatus is working correctly.

Figure 6 of the accompanying drawings shows an example of the circuitry which may be employed in the apparatus of the present invention for effecting the required response from the sensor. The sensor S is energised by receiving the infra red light which has been transmitted through the optical fibres. A negative switching wire W runs from the sensor to a timer coil T and also to one side of a bicolour LED. When the power is switched on, the beam reaching the sensor is unbroken by the flow of fluid which causes a signal to be transmitted through the negative switching wire to energise the timer coil which is set to run for a

predetermined period of time. In the normal state, the wire leads through timer contact T_1 to result in illumination of the green side of the LED. However, if the timer T reaches the end of its cycle without receiving a further signal, the timer contact T_1 is broken and timer contact T_2 closes thereby causing the red side of the LED to be illuminated to indicate that no fluid has passed through the drip during a complete cycle of the timer. If fluid does flow through the apparatus, this is detected by a reduced intensity of light reaching the sensor which results in the transmission of a signal to the timer T to reset the coil to the beginning of its cycle. Thus, if drips of fluid keep passing through the apparatus, the timer will be continually reset and the light will remain green. Resistors R_1 and R_2 are provided to reduce the intensity of the current passing through the LED.

The electronic circuitry for use in the apparatus of the present invention is minimal and fits easily in the small box 6 having the LED visible on a side thereof. The infra red emitter may be contained within the box and a battery for providing power to the system may also be situated therein. Generally, a battery of at least 12-30v will be required to ensure sufficient energy is supplied to the sensor. Preferably, circuitry having a low current demand is employed in the apparatus. The light emitting diode may be a tricolour LED with the illumination of a third colour, such as amber, indicating that the battery is low. Optionally, a battery recharger may be included within the box for linking to a mains supply to recharge the battery, for example, whilst the patient is in bed asleep. The box may be provided with a clip

to allow convenient attachment to the drip stand or to the patient.

Additionally, the circuitry may be linked to a beacon positioned by the bed of the patient or at a nursing station which lights up or flashes when the flow of fluid through the drip stops for a given period of time. This will be readily visible to the nursing staff who may then adjust the drip accordingly. Additionally or alternatively, the sensor may be linked to computer monitors provided at a nursing station which may be checked at regular intervals by the nursing staff without disturbing the patients. The apparatus may also give out an audible alarm if an intravenous drip has stopped administering fluid to alert the nursing staff.

The amount of fluid administered to the patient may also be monitored using the method and apparatus of the present invention. The amount of light which passes through a drop of fluid and is detected by the sensor may be used to establish the volume of fluid administered using the appropriate calibrations. Each monitor could collect data for a large number of drips and thereby provide an accurate record of the fluids which are being given to a large number of patients.

It is to be appreciated that an alternative light signal may be used in the method and apparatus of the present invention instead of infra red, such as a beam of red light.

Referring to Figures 7 and 8 of the accompanying drawings, another embodiment of the method and apparatus of the present invention is illustrated in which the apparatus may be set

at a particular rate of flow of fluid through the intravenous drip and has means for activation of a visual and/or audible alarm should the measured rate fall below or rise above a predetermined tolerance level of the preset value.

The sensor bracket or clip is attached around the chamber or drip pod of the intravenous drip as hereinbefore described and the apparatus is switched on by means of the power switch 40 provided on the monitor unit or housing 42 (see Figure 8). The administration of the fluid through the drip is commenced and the monitor detects the drips by means of the breakage of a beam of light which is transmitted through the chamber. The monitor unit 42 is able to detect the rate of flow of liquid through the chamber (for example, in drips per minute or ml per hour) and provides a reading on an LCD unit 44 provided on the housing. For example, generally twenty drips of clear fluid corresponds to 1ml of liquid being administered. More viscous liquids such as blood, require fifteen drips to administer 1ml of fluid. This can be used to determine the amount of fluid administered per minute or hour. Once the desired rate is achieved and becomes constant, the "set" switch 46 provided on the monitor unit is pressed such that the unit is set at the desired rate. A clear indicator 48 is illuminated in green when the rate detected by the monitor unit falls within a predetermined tolerance of the set rate, for example $\pm$ 50%. If the rate falls outside the tolerance level or if no drops are detected within a predetermined period of time, the clear indicator turns red and/or an audible alarm is activated.

The clear indicator also flashes when drips are passing through the chamber to demonstrate that the apparatus is functioning correctly as hereinbefore described. Additionally, a low power indicator 50 is provided on a monitor unit.

Figure 9 of the accompanying drawing illustrates an alternative design for the monitor unit of the present invention. Identical features already described in relation to Figure 8 are given the same reference numerals. The monitor unit is attached by a hook 60 to a branch 62 of the drip stand 64.

Referring to Figures 10a to 10b of the accompanying drawings, a preferred embodiment for the through-scan bracket is illustrated. The through-scan 70 is in the form of a C-shaped bracket or clip 72 having two arms 74 extending obliquely from the rear thereof. The arms may be pressed together to cause divergence of the free ends 76 of the C-shaped bracket thereby enabling the bracket to be slotted onto the drip pod, or chamber (not shown). Releasing pressure from the arms causes the bracket to relax and grip the chamber. This is achieved by means of a living hinge provided in the central rear section of the bracket (not shown) or forming the bracket from a reinforced elastomeric material to allow the bracket to resume its original shape after being distorted to fit around the chamber.

Through-holes 78 are provided through opposite sides of the C-shaped bracket to allow passage of the beam of light. Protrusions 80 extend from the holes for connection of the optical

fibre to the bracket and have a corresponding channel 82 therethrough. The arms of the bracket are also provided with gripping means on their outer surface, such as ribbing 84.

A number of further accessories may be provided for use with the apparatus of the present invention, such as a receiver unit for supporting the monitor unit or housing which may be, for example, wall mounted. A coiled extension lead may also be provided to allow the bracket and intravenous drip to be located a distance from the monitor unit. This enables the intravenous drip to be taken into high risk areas, such as scanning rooms, and the monitor may be left outside. Additionally, a lead may run from the optical fibre to a glass bulb or LED located at a convenient site, such as the top of the drip or drip stand, for example, being placed through the eye provided in the fluid bag of the intravenous drip.

A transmission of a light signal across a through-scan via optical fibres has not previously been used for detecting dripping fluids, such as saline solution and it is surprising that good results are achieved for transparent liquids. The use of an infra-red or other light signal, such as red light is desirable for hospital equipment since the beam of light has no detrimental effect on the fluid being administered and does not effect any other apparatus which may be operating in the vicinity of the intravenous drip. For this reason, equipment which utilises such signals do not require permission before being used in hospitals whereas all other signals, such as radiation, do have to be tested to conform with specific legislation.

Additionally, the provision of the electronic circuitry remote from the through-scan has a number of advantages. The bracket is cheaper and easier to manufacture and maintain if the electronics are not contained in the walls of the bracket. It is much cheaper to house the components on a circuit board within the housing than provide them within the bracket. The bracket is also lighter and may be taken into high risk scanning areas without any of the accompanying circuitry.

The components used in the apparatus of the present invention are relatively cheap compared to other hospital equipment, such as pericycle pumps. The apparatus is also small, compact and lightweight thus making it suitable for transportation by the patient. The apparatus may also be taken into most hospital departments, such as the radiography department, which is not possible with other devices which can interfere with radiation.

The ability to check and monitor an intravenous drip without the necessity of a nurse having to physically look at the tubing to see that fluid is flowing through the drip will reduce the high work load of nursing staff in a service sector where funds are limited and there is a shortage of trained staff. Additionally, the patient is not inconvenienced by the nurse having to frequently check the drip, particularly through the night.

CLAIMS

1. An apparatus for monitoring the flow of fluid through an intravenous drip comprising a signal transmitter for transmitting a signal through a fluid flow passage, a sensor for detecting the signal transmitted through said passage and at least one visible or audible indicator for indicating the presence or absence of a flow of fluid through the drip.

2. An apparatus as claimed in claim 1, wherein the signal is infrared light produced from an infrared emitter.

3. An apparatus as claimed in claim 1, where the signal is red light produced from a light source.

4. An apparatus as claimed in claim 1, 2 or 3 wherein the signal is transmitted to and/or from the intravenous drip by means of an optical fibre.

5. An apparatus as claimed in claim 1, 2 , 3 or 4 wherein a through-scan, in the form of a bracket, is provided for placement around a region of the intravenous drip for allowing transmission of the signal across the passageway of the flow of fluid.

6. An apparatus as claimed in claim 5, wherein the bracket is hinged to allow easy placement around a region of the drip.

7. An apparatus as claimed in claim 5 or claim 6 wherein the through-scan is in the form of a C-shaped bracket having two arms extending from the rear-thereof opposite the opening in the bracket, whereby the arms may be pressed together to cause divergence of the free ends of the C-shaped bracket.

8. An apparatus as claimed in claim 7, wherein the bracket is provided with a living

hinge or is comprised of an elastomeric material to allow divergence and convergence of the free ends of the bracket.

9. An apparatus as claimed in any one of the preceding claims wherein a remote housing is provided for containing components, such as electronic circuitry, the sensor and the signal emitter.

10. An apparatus as claimed in any one of the proceding claims wherein the indicator is a light emitting diode.

11. An apparatus as claimed in claim 10, wherein the indicator is a bicolour LED which emits one colour when fluid is flowing through the apparatus and changes to another colour when the flow of fluid stops for a predetermined period of time.

12. An apparatus as claimed in claim 10 or 11 wherein the light emitting diode flashes with each drip of fluid which passes through the intravenous drip.

13. An apparatus as claimed in any one of the preceding claims wherein the sensor is linked to suitable electronic circuitry to allow the rate of flow of fluid through the intravenous drip to be determined.

14. An apparatus as claimed in claim 13, wherein the rate is displayed on a display unit.

15. An apparatus as claimed in claim 14, wherein the rate is displayed on a LCD or LED unit.

16. An apparatus as claimed in claim 13, 14 or 15 wherein the apparatus may be preset at a particular rate of fluid flow whereby an indicator emits a specified colour or sign when the rate detected falls within a specified range of the preset value and changes to another colour or sign if the rate falls below or rises above a

predetermined tolerance level of the preset value.

17. An apparatus as claimed in any one of the preceding claims wherein the apparatus is powered by means of a battery or mains supply.

18. An apparatus as claimed in claim 17 wherein a low battery indicator is provided to indicate when the battery requires recharging or replacement.

19. An apparatus as claimed in any one of the preceding claims further comprising a beacon which is illuminated when the flow of fluid has stopped for a given period of time or the rate of fluid flow has risen above or fallen below a preset value.

20. An apparatus as claimed in any one of claims 4 to 19 further comprising a wire extending from the optical fibre to a glass bulb or LED for placement in a convenient location.

21. An apparatus is claimed in any one of the preceding claims, wherein the sensor is linked to a computer monitor.

22. An apparatus as claimed in any one of the preceding claims, further comprising means for monitoring the volume of fluid administered through the drip.

23. A method for monitoring the flow of fluid through an intravenous drip comprising the steps of transmitting a signal through a fluid flow passage and detecting the signal transmitted through the passage whereby detection of a signal of a given intensity activates an audible or visible indicator.

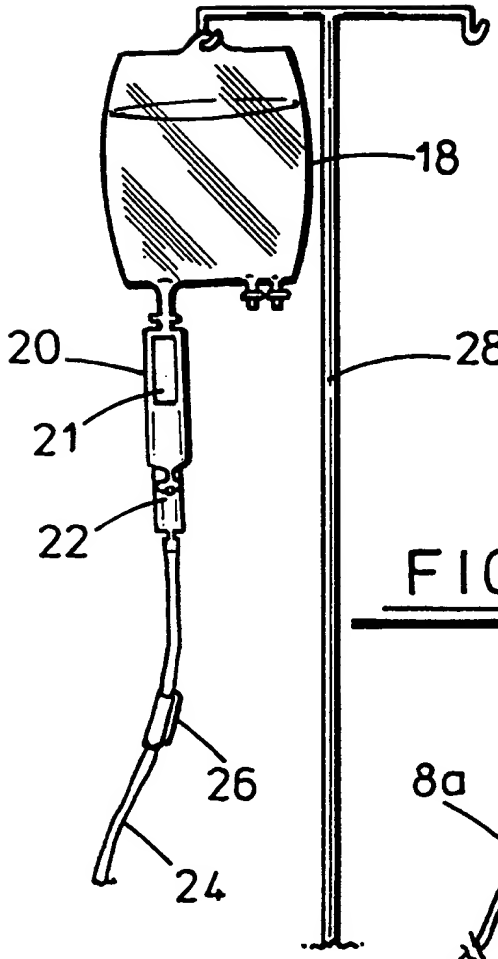

FIG. 1

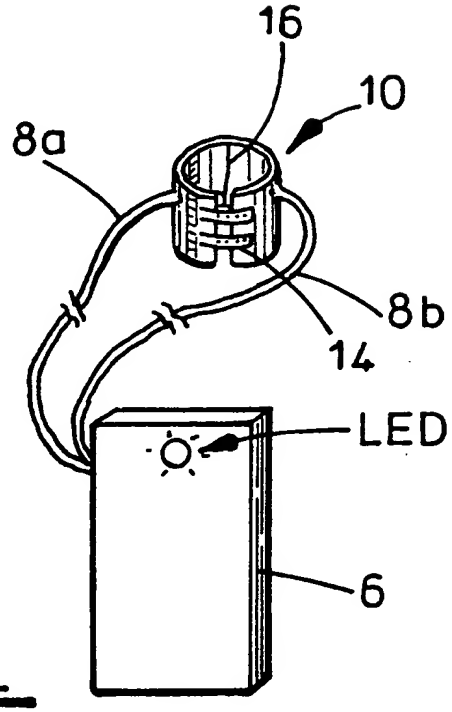

FIG. 2

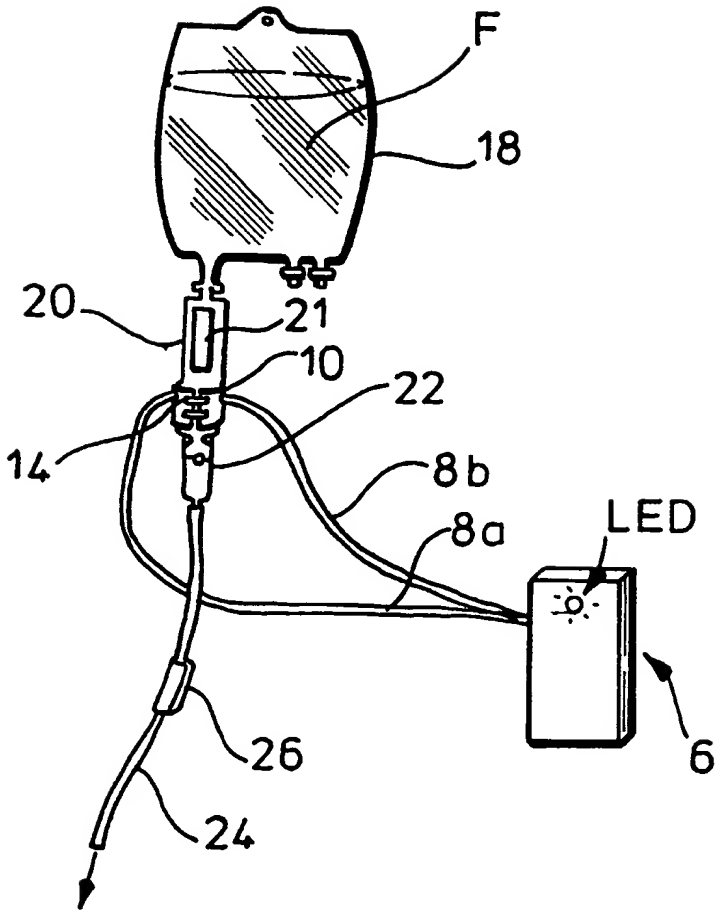

FIG. 3

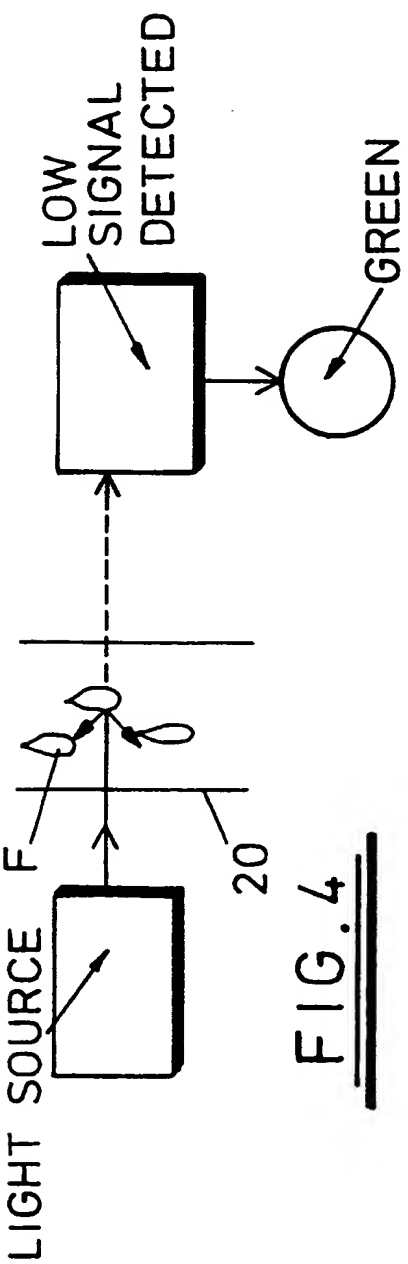
LOW SIGNAL DETECTED
GREEN
LIGHT SOURCE
F
20

FIG. 4

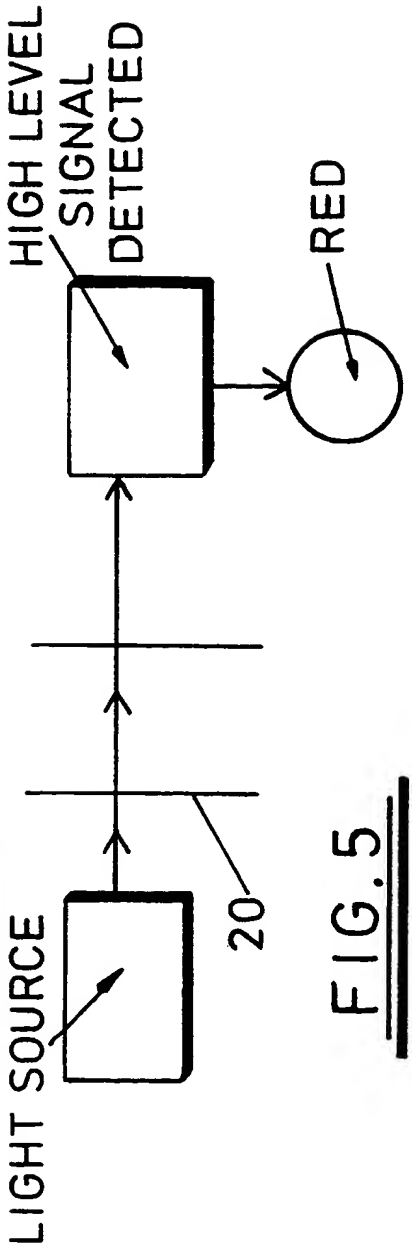
HIGH LEVEL SIGNAL DETECTED
RED
LIGHT SOURCE
20

FIG. 5

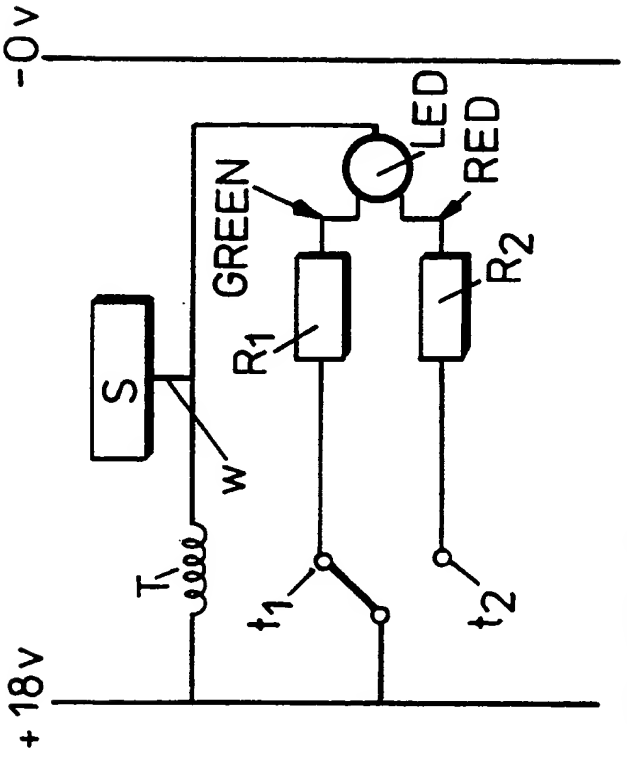

FIG. 6

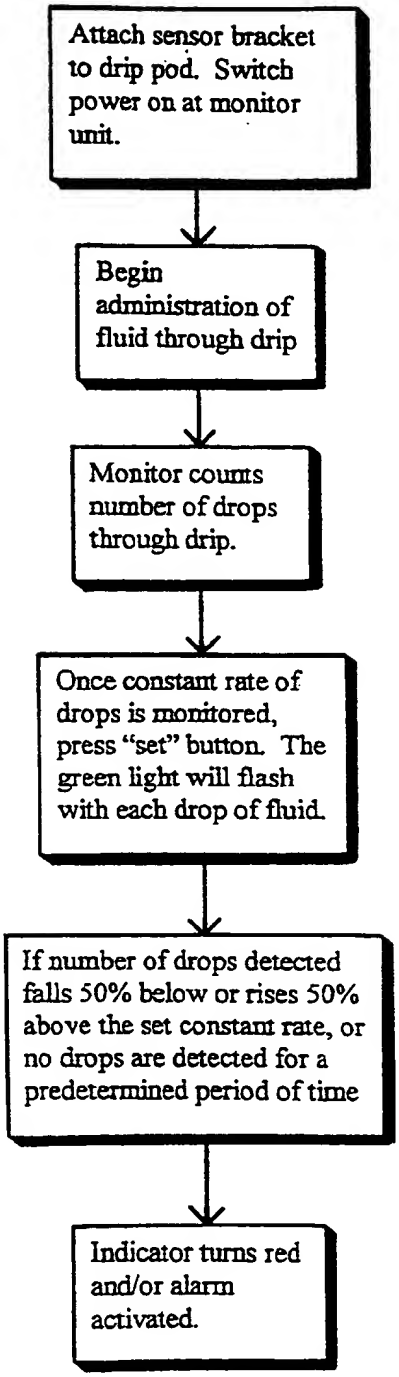
Attach sensor bracket to drip pod. Switch power on at monitor unit.
Begin administration of fluid through drip
Monitor counts number of drops through drip.
Once constant rate of drops is monitored, press "set" button. The green light will flash with each drop of fluid.
If number of drops detected falls 50% below or rises 50% above the set constant rate, or no drops are detected for a predetermined period of time
Indicator turns red and/or alarm activated.

FIG. 7

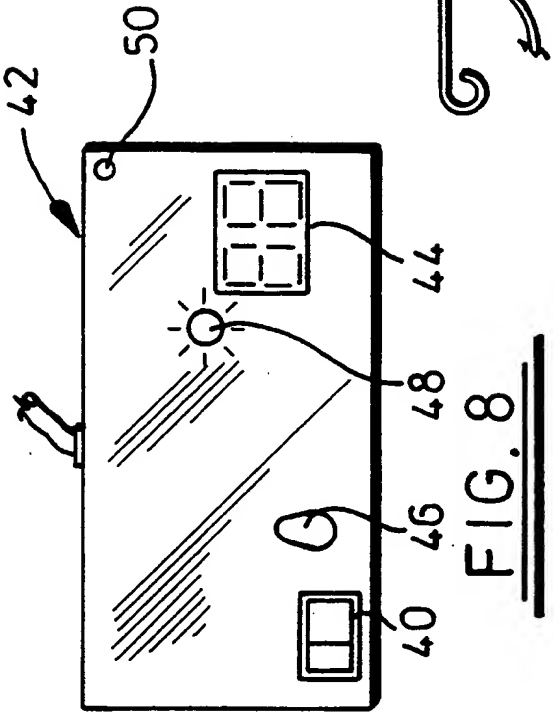

FIG. 8

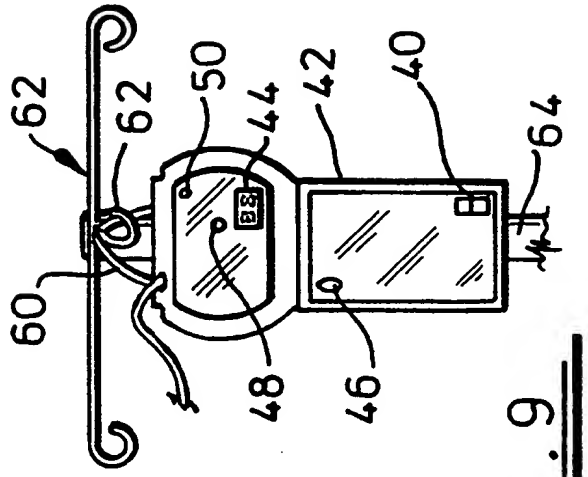

FIG. 9

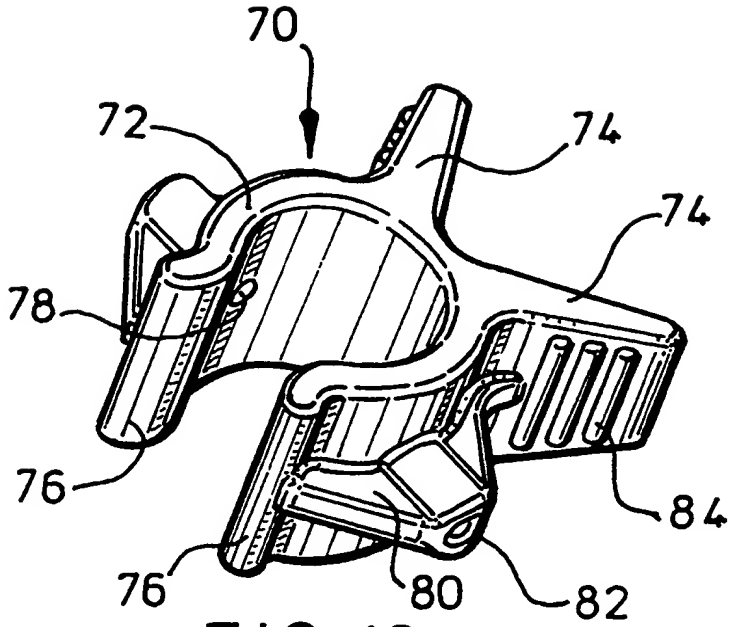

FIG.10a

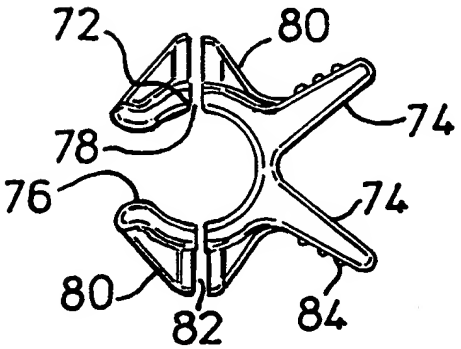

FIG.10b

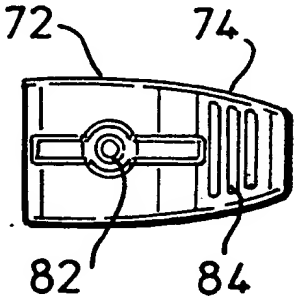

FIG.10c

INTERNATIONAL SEARCH REPORT

Inte .onal Application No
PCT/GB 99/00508

A. CLASSIFICATION F SUBJECT MATTER
IPC 6 A61M5/168

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 A61M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 576 592 A (DANBY HAL C) 18 March 1986 see column 4, line 43 - line 68; figures	1-5,9-23
X	US 4 321 461 A (WALTER JR DAVID E ET AL) 23 March 1982 see column 11, line 44 - column 12, line 4	1-5,9-23
X	DE 28 30 512 A (HEWLETT PACKARD GMBH) 24 January 1980 see page 6, line 25 - line 36; figures	1-3,5-23
X	WO 96 17637 A (MIDEX MARKETING LTD ;MOLKO ALBERT (LU)) 13 June 1996 see page 15, line 34 - page 16, line 6; figure 4	1-3,5-23

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
15 June 1999	23/06/1999

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Clarkson, P

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INTERNATIONAL SEARCH REPORT

Inte ional Application No
PCT/GB 99/00508

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	FR 2 668 369 A (SERVELLE LUCIEN) 30 April 1992 see page 4, line 5 - line 28; figure 1	1-3,5-23

1

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INTERNATIONAL SEARCH REPORT

Information on patent family members

Inte .onal Application No
PCT/GB 99/00508

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